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# (12) UK Patent Application (19) GB (11) 2 298 519 (13) A

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(56) Documents Cited  
GB 2217917 A      GB 2023348 A      GB 1178314 A  
GB 0865740 A      EP 0499477 A2      EP 0089563 A2  
SU 000802684 A      US 4995586 A

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## (54) Indicating operation of a solenoid valve

(57) The solenoid valve 10 includes a switch 18, 22 arranged to be operated directly in response to the presence of the armature 16 of the valve in a retracted position. The power exerted to move the solenoid armature 16 into the retracted position is reduced in response to operation of the switch, by reducing the proportion of the coil winding 12 to which current is supplied. The switch may alternatively comprise a reed or Hall effect switch.

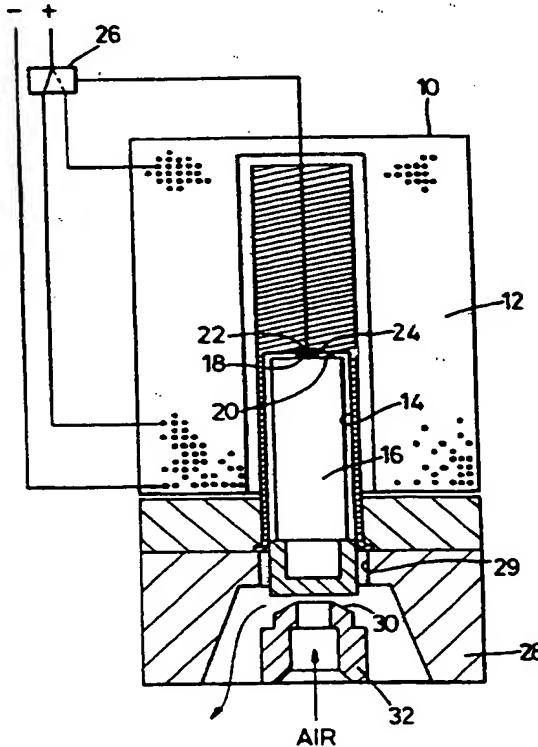


Fig. 1

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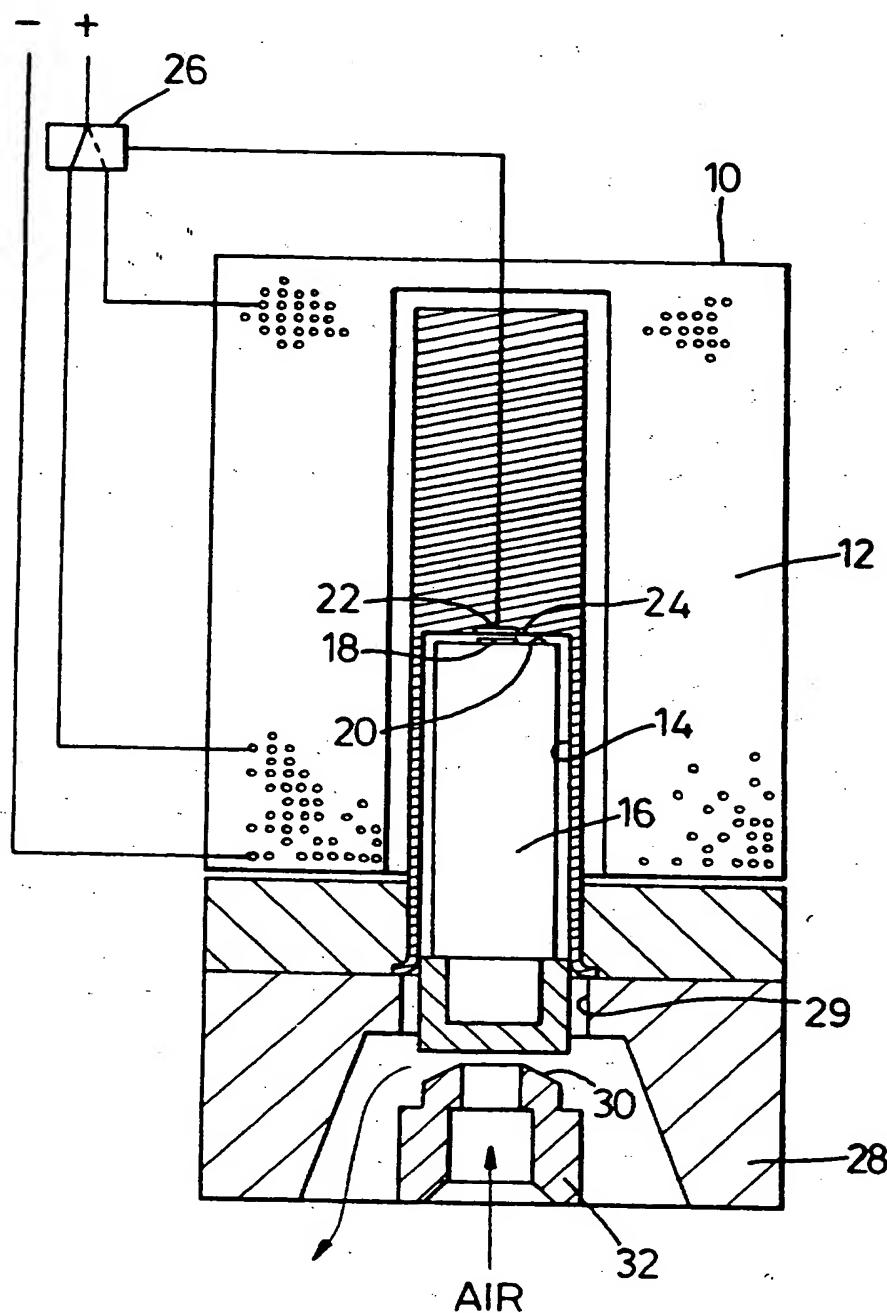


Fig. 1

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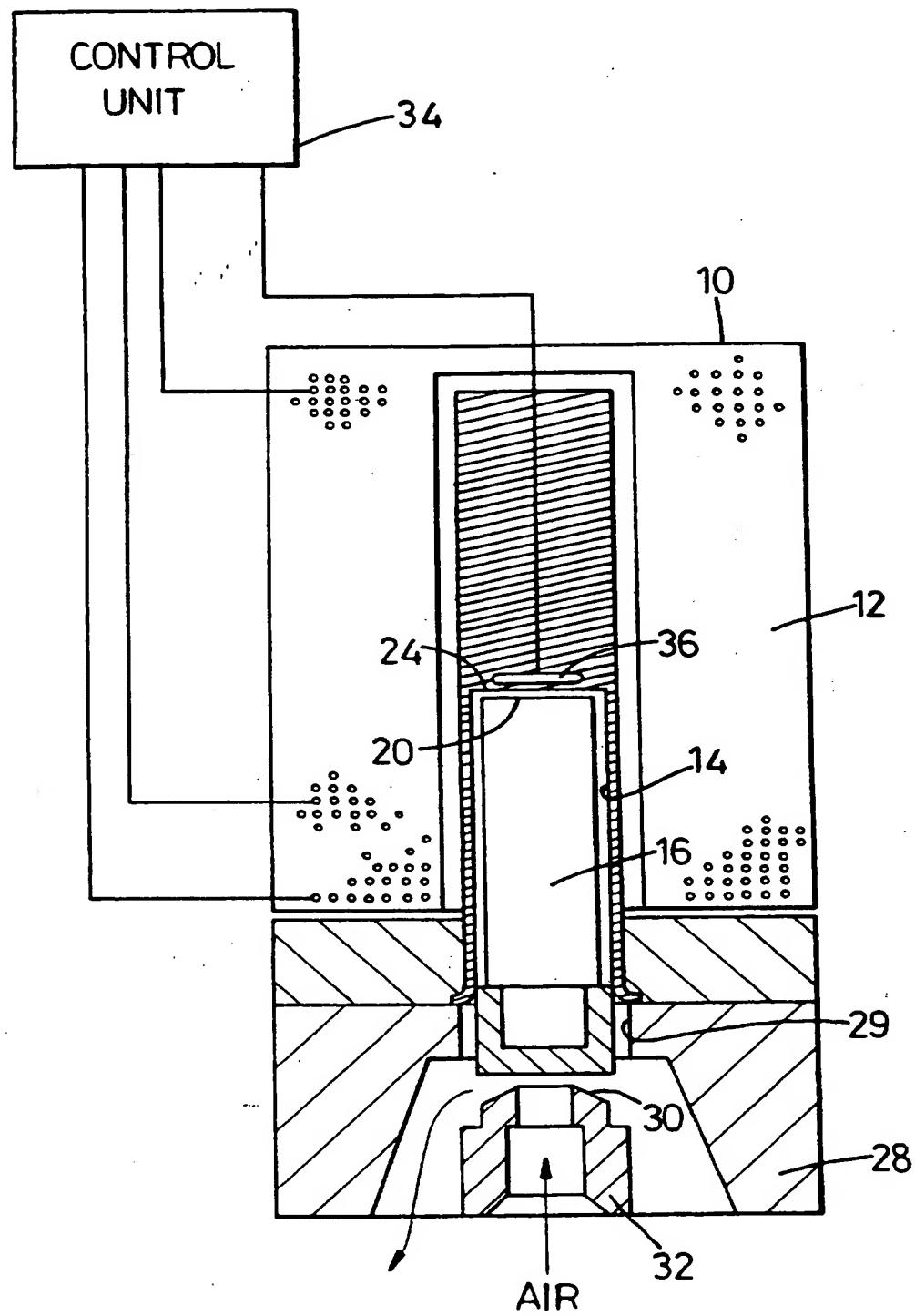


Fig. 2

A SOLENOID VALVE

The invention relates to a solenoid valve.

It is known to use solenoid valves in the pneumatic system in the suspension of a wheeled vehicle. The air in the pneumatic system is kept dry to avoid the possible problem of a wet valve icing up and freezing in its normally closed position. The need to dry the air for the pneumatic system and maintain the air in a dry condition is a drawback of existing systems. The existing system uses a "hit and drop" method which assumes that the solenoid valve is free to operate so that the initial hit, which may be a high current input or the activation of a large number of electromagnetic retraction coils is assumed to retract the armature of the valve and the subsequent reduced current or activation of a smaller number of electromagnetic retraction coils merely retains the armature in its retracted position.

According to the invention there is provided a solenoid valve including a switch which is arranged to be operated directly in response to the presence of the armature of the valve in a retracted position.

In this way, operation of the switch will indicate that the armature has been retracted by the solenoid and, for example, reactivation is not required.

Preferably, means is provided to reduce the power exerted to move the solenoid armature into the said retracted position in response to operation of the switch. In a preferred embodiment, the means is arranged to reduce the number of coils to which current is supplied. The means may comprise a relay which is operated by the switch. Thus, if a solenoid valve is frozen, the power to retract the solenoid will not be reduced until the switch is operated as a result of the armature moving into and occupying its retracted position. An additional benefit is that the solenoid coils will heat up as a result of the continued supply of current to them which will assist in melting any ice holding the valve closed.

The switch may be provided at the back of the blind opening in which the armature moves.

The switch may be a contact switch and preferably a contact of the switch is provided at the back of the blind opening in which the armature moves and the switch is arranged to be operated by contact between the armature and the contact. Alternatively, the switch may be a proximity switch such as a reed switch or a Hall effect switch.

Two embodiments of the invention will now be described by way of example and with reference to the accompanying drawings.

Fig. 1 is a side view in cross-section of the first embodiment of the invention; and,

Fig. 2 is a side view in cross-section of the second embodiment of the invention.

5       The solenoid valve 10 of the first embodiment of the invention comprises a cylindrical coil winding 12 which defines a blind cylindrical opening or bore 14 therein. An armature 16 is slidable into and out of the opening 14. A contact 18 is provided on the back surface 20 of the  
10 armature 16 and is arranged to contact a further contact 22 which is provided at the back wall 24 of the blind opening when the armature 16 is in its retracted position. The contact 22 is connected to a relay 26 which is connected to the coil winding 12 at two different positions to enable  
15 all of the winding or just a part of the winding to be activated. The solenoid valve 10 is shown on a base 28 which includes a bore 29 to receive the end of the armature 16 which is arranged to abut and seal upon the seat 30 of an air supply nozzle 32.

20       In normal use, if the valve 10 is to be opened, current is supplied to the relay 26 which activates the entire coil winding 12 which acts to retract the armature 16. When the armature 16 has moved back into the bore 14 the contacts 18,22 will touch and the relay 26 will be activated to cut  
25 off the current supply to the majority of the coil winding 12 so that a reduced force of sufficient to retain the

armature 16 in the blind opening 14 is provided. If the end of the armature 16 is iced onto the seat 30 of the nozzle 32, the relay 26 will continue to supply the entire coil winding 12 until the continued force and the heat produced from the coils causes the ice bond to break releasing the armature 16 to move back into the opening 14 resulting in operation of the contact switch 18,22 and subsequent operation of the relay 26.

Fig. 2 shows the second embodiment which is similar to the first and the corresponding features will be identified by the same reference numerals. Only the differences from the first embodiment will be described. The relay 26 is omitted from the second embodiment and instead an electronic control unit 34 controls the section of the coil winding which is activated. The contacts 18,22 are not provided, but instead a reed switch 36 is provided at the back wall 24 of the bore 14. The reed switch 36 is connected to the electronic control unit 34 and is operated by the proximity of the armature 16 when the armature 16 reaches the back 24 of the bore 14.

In a further embodiment the reed switch of the second embodiment may be replaced by a Hall effect switch.

CLAIMS

1. A solenoid valve including a switch which is arranged to be operated directly in response to the presence of the armature of the valve in a retracted position.
2. A solenoid valve as claimed in claim 1, wherein means is provided to reduce the power exerted to move the solenoid armature into the said retracted position in response to operation of the switch.
3. A solenoid valve as claimed in claim 2, wherein the means is arranged to reduce the number of coils to which current is supplied.
4. A solenoid valve as claimed in any preceding claim, wherein the switch is provided at the back of the blind opening in which the armature moves.
5. A solenoid valve as claimed in any preceding claim, wherein the switch is a contact switch.
6. A solenoid valve as claimed in claim 5, wherein a contact of the switch is provided at the back of the blind opening in which the armature moves and the switch is arranged to be operated by contact between the armature and the contact.

7. A solenoid valve as claimed in any of claims 1 to 4, wherein the switch is a proximity switch.
8. A solenoid valve as claimed in claim 7, wherein the switch is a reed switch.
9. A solenoid valve as claimed in claim 7, wherein the switch is a Hall effect switch.
10. A solenoid valve substantially as described herein with reference to Fig. 1 or Fig. 2 of the accompanying drawings.

Application number  
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## Relevant Technical Fields

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 (ii) Int Cl (Ed.6) F16K 37/00

Search Examiner  
C D STONEDate of completion of Search  
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## Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

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Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2217917 A	(TOKYO KEIKI) see switch 38, Figure 1	1
X	GB 2023348 A	(DEERE) see switch 94	1-6
X	GB 1178314	(DEWRANCE CONTROLS)	1, 8
X	GB 865740	(CANNON) see switch 16	1-5
X	EP 0499477 A2	(SULE)	1, 5
X	EP 0089563 A2	(LEYBOLD-HERAEUS) see switches 28a, 28b	1, 5
X	US 4995586	(HYDAC TECHNOLOGY)	1, 7
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